



## **NASA STTR 2011 Phase I Solicitation**

### **T1.03 Information Technologies for Intelligent Planetary Robotics**

**Lead Center: ARC**

The objective of this subtopic is to develop information technologies that enable robots to better support planetary exploration. Intelligent robots are already at work in all of NASA's Mission Directorates and will be critical to the success of future exploration missions. The 2010 NASA "Robotics, Tele-Robotics, and Autonomous Systems Roadmap" (RTA Roadmap) indicates that extensive and pervasive use of intelligent robots can significantly enhance exploration, particularly for surface missions that are progressively longer, more complex, and must operate with fewer ground control resources.

Robots can do a variety of work to increase the productivity of planetary exploration. Robots can perform tasks that are highly-repetitive, long-duration, or tedious. Robots can perform tasks that help prepare for

subsequent human missions. Robots can perform "follow-up" work, completing tasks started by astronauts. Example tasks include: robotic recon (advance scouting), systematic site surveys, documenting sites or samples, and unskilled labor (site clean-up, close-out tasks, etc).

The RTA Roadmap identifies three key areas for improvements in robotics:

- Technology should aim to exceed human performance in sensing, piloting, driving, manipulating, rendezvous and docking.
- Technology should target cooperative and safe human interfaces to form human-robot teams.
- Autonomy should make human crews independent from Earth and robotic missions more capable.

Thus, proposals are sought which address the following topics:

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- Advanced user interfaces for remote robotic exploration, which include Web-based collaboration methods, panoramic and time-lapse imagery, support for public outreach/citizen science, social networking and/or visualization of geospatial information. The primary objectives are to enable more efficient interaction with robots, to facilitate situational awareness, and to enable a broad range of users to participate in robotic exploration missions.
  - Ground control data systems for robotic exploration. Proposals should focus on software tools for planning variable-duration and adjustable autonomy command sequences; for event summarization and notification; for interactively monitoring/replaying task execution; for managing; and/or for automating ground control functions.
  - Mobile robot navigation (localization, hazard avoidance, etc.) for multi-km traverses in unstructured environments. Novel "infrastructure free" techniques that utilize passive computer vision (real-time dense stereo, optical flow, etc.), active illumination (e.g., line striping), repurposed flight vehicle sensors (low light imager, star trackers, etc.), and/or wide-area simultaneous localization and mapping (SLAM) are of particular interest.
  - Robot software architecture that radically reduces operator workload for remotely operating planetary rovers. This may include: on-board health management and prognostics, on-board automated data triage (to prioritize information for downlink to ground), and learning algorithms to improve hazard detection and selection of locomotion control modes.